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PRESENT AND POST-WAR HEALTH PROBLEMS IN CONNECTION WITH PARASITIC DISEASES[1]

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As a nation without imperialistic aims and with few colonial possessions, we have viewed with considerable nonchalance the tropical disease problems of other countries. Now that we are engaged in an all-out war on many fronts, we are frantically endeavoring to absorb and put into practice knowledge of these exotic diseases. For the moment, most of these problems are military problems, but sooner or later they are apt to become public health problems of direct concern to our civilian population.

Our past military campaigns in tropical areas have been confined to small-scale operations in Cuba, Puerto Rico, the Philippines and briefly in Central America. Now our troops are serving by the thousands in such hotbeds of exotic disease as Africa, India, China and the South Pacific. While every effort is being made by our military authorities to practice effective preventive medicine in these areas, it is inevitable that some of our troops will contract one or more tropical diseases and will return to the United States as infected individuals. Already the homeward trek of these men has begun. The return of military personnel from all these areas will probably constitute a cumulative introduction of tropical disease equaled or exceeded only by such introduction during the slave-trading days. It is well, therefore, to consider some of the possibilities which confront us and to ponder the relationship of these possibilities to civilian health.

Some of the diseases of greatest importance from a military standpoint and possibly from a subsequent civilian standpoint are those caused by protozoan and

[1] Presented before the Section on Epidemiology, War-time Conference, American Public Health Association, New York, October 12, 1943.

helminth parasites as well as others which are transmitted by various species of insects and other intermediate hosts.

Many of these parasitic diseases are characterized by a relatively long incubation period, by pronounced chronicity, by lack of permanent immunity and by difficulties in diagnosis; there are no successful means of immunizing an individual against them, and for many of them we have no satisfactory treatment. These facts all add to the probability that the parasitic diseases will be the ones most likely to be brought back by returning troops and the ones which may well prove to be of considerable concern from a public health standpoint.

PROTOZOAL DISEASES

Malaria. This disease has always been the scourge of armies operating in tropical or sub-tropical countries and we can only expect that the present conflict will offer no exception to this rule. In our brief military excursion in the Spanish-American War, over half of our troops contracted malaria. In World War I our malaria problem was confined to the southern camps and extra-cantonment areas. For the most part our troops were engaged in temperate or cold climates where malaria was not endemic. But now the sons of the veterans of that war are in combat in some of the most highly malarious areas on the globe. Under these circumstances, we may expect a considerable morbidity rate from this disease.

Many infected individuals will return as carriers of the disease and many will go back to their homes in parts of the country which have long been free of the infection. A proper concentration of carriers in areas where there is a suitable concentration of vectors will lead to the establishment of new endemic centers of malaria. Furthermore, there is the probability of the introduction of new strains as well as new species in areas in which all the several species do not at present exist. We already have isolated examples of the potentialities of such occurrences even with the introduction of a limited number of carriers. For instance, Craig[2] has reported the incident of the National Guard company from Connecticut, the members of which contracted *Plasmodium falciparum* infection in southern camps during the Spanish-American War and introduced this species in their home community on their return from the service, a community in which only *P. vivax* had previously been known.

Matheson[3] has cited the Aurora, Ohio, outbreak of 1934 to show the explosive effect of the introduction of a single case in a community, in which a suitable mosquito host was available.

During and following World War I, malaria reappeared in England after a lapse of sixty years. The outbreaks resulted from the introduction of the disease by returning soldiers, mostly by those who had served in the Macedonian campaign.

We may anticipate as a post-war development the probable occurrence of numerous instances of the above-mentioned sort. In the present endemic areas, we may expect introduction of new strains to which even already infected individuals may have little or no resistance. In the many parts of the United States in which anopheline vectors are found outside of the infected zones, it is probable that we shall see localized outbreaks over a period of years.

The situation calls for farsighted planning to meet the eventualities which we are bound to have to face. It is a question whether as a public health measure we should not now be placing even more emphasis on control of anopheline mosquitoes in endemic zones and extending this control work into areas which have long been free of the disease. Also, in some of these latter areas we must know more about the distribution and ecology of vectors.

Amoebiasis. Like malaria this disease is endemic in the United States, where about 10 per cent. of individuals examined in surveys have been found infected. Following the last war, there was some apprehension that soldiers returning from overseas might spread the disease widely over the country. In this connection Boeck and Stiles[4] made a total of 13,043 examinations of 8,029 individuals for intestinal parasites. These persons included overseas veterans, troops stationed in the United States, persons with no military service and persons whose service connection was unknown. The incidence of *Endamoeba histolytica* in overseas soldiers was no higher than that encountered in the other groups.

Kofoid, Kornhauser and Plate[5] found an incidence of *E. histolytica* of 10.8 per cent. in 1,200 overseas soldiers and an incidence of only 3 per cent. in 300 on home service. However, the incidence in the former group was not materially different from that encountered generally in surveys in this country.

As with malaria, however, we are faced with a situation somewhat different from the one that confronted us in the first World War. Some time ago, an eminent medical officer remarked that amoebic dysentery has never been a military problem except in the Philippines during the Spanish-American War and the In-

[2] Charles F. Craig, Publication No. 15, Am. Asn. Adv. Science, Washington. 1941, pp. 131–134.

[3] Robert Matheson, Publication No. 15, Am. Asn. Adv. Science, Washington. 1941, pp. 157–162.

[4] William C. Boeck and Ch. Wardell Stiles, *Hygienic Lab. Bull.* 133, Treasury Dept., Wash., 1923, 198 pp.

[5] Charles A. Kofoid, Sidney I. Kornhauser and J. T. Plate, *Jour. Am. Med. Asn.*, 72: 1721–1724, June 14, 1919.

surrection. This statement is of course true, but the fact must not be overlooked that the Philippine campaign is the only one of any consequence which we had fought in a tropical country. At the present time our troops are in combat in areas in which strains of *E. histolytica* are particularly virulent for those who have not been previously exposed to such strains. Experience in the British Army in North Africa indicates that about one eighth of the hospitalized dysentery cases were due to *E. histolytica*. On the other hand, amoebic dysentery is said[6] to be the prevailing form attacking British troops in India.

The protection of troops against the dysenteries is difficult under combat conditions but the water purification tablets now provided for sterilizing water in canteens are effective under most conditions for the destruction of cysts of *E. histolytica*. The hyperchlorite ampule is still used in the Army Lyster bag but effective cysticidal action is not obtained without, in effect, superchlorination and adequate exposure time. Portable sand filters such as used in advanced zones will probably remove most amoeba cysts from water provided such units are operated properly. Fly-borne dysentery is not uncommon in troops under certain conditions. Craig[7] has called attention to an epidemic of amoebic dysentery from this source in troops on the Mexican border in 1916, while the widespread outbreak of dysentery in combat divisions taking part in the Marne-Aisne offensive in 1918 was undoubtedly due mostly to the spread of infection by flies, as can be readily attested by the writer.

Consequently, even though the best sort of protection is provided, it is not always possible under combat conditions to make use of available facilities and the dysenteries must be reckoned with in any military campaign. In the case of amoebic dysentery, we may expect the return of a certain number of infected individuals at the end of this war. What effect these carriers will have on our civilian health is problematical, but it is reasonable to assume that their dispersal may well lead to a higher morbidity rate from amoebiasis, and that perhaps new and more virulent strains may be introduced.

Leishmaniasis. Visceral leishmaniasis or kala-azar occurs throughout the Mediterranean littoral, the Near East, India and China. In addition, it has been found in certain parts of South America. Cutaneous leishmaniasis or oriental sore has much the same distribution as kala-azar. Further, we have in parts of South America and in Mexico the mucocutaneous form known commonly as espundia.

Other than a few imported cases, leishmaniasis has not occurred in the United States. Even though the method of transmission of the visceral type of the disease has been definitely established by Swaminath, Shortt and Anderson,[8] as occurring through the bite of sandflies of the genus *Phlebotomus,* we have difficulty in appraising post-war significance of the disease as a public health problem in the United States. It is evident that protection against the vectors of the disease is often impracticable, if not impossible, and that with present diagnostic methods only the most obvious cases are detected. Consequently, we may surmise that infected individuals will return to this country and may serve as reservoirs of infection, possibly over a long period of time. Three species of *Phlebotomus* are described from the United States, and others are known. One species, *P. diabolicus,* which occurs in Texas, is said to be a vicious feeder on man. As a public health measure, it is believed that effort should be made to determine the distribution and ecology of domestic species of *Phlebotomus* and to ascertain the infectibility of *P. diabolicus.* However, it seems probable that this disease will not be one of those of greatest importance which may be introduced by military personnel.

Trypanosomiasis. The possibilities for the establishment of African sleeping sickness seem much more remote than those in the case of other tropical diseases. We do not have in this country species of *Glossina,* a fact which militates against the disease gaining a foothold in the continental United States. We do have other blood-sucking flies, including tabanids and *Stomoxys calcitrans;* the latter has been incriminated as one of the vectors of the disease. However, as African trypanosomiasis has exhibited no tendency to spread extensively in areas where species of *Glossina* do not abound, it would appear that the disease is unlikely to become established in areas where dependence on transmission is limited to other vectors.

The case for the establishment of Chagas' disease is perhaps of more concern. Naturally infected *Triatoma* have been found in various areas in the South, Southwest and California, and reservoir hosts of *Trypanosoma cruzi* are known from some of these areas. No human cases of the disease have been discovered to date in the United States. However, we are sending on various missions numerous individuals to endemic areas in Central and South America and furthermore are importing labor from south of the Rio Grande to work in regions where infected *Triatoma* have been located. It is hoped that fortuitous conditions will not bring about the introduction of human cases and the spread of the disease in this country.

[6] "Amoebic Dysentery as a Water-borne Disease." Editorial, *Indian Med. Gaz.,* 78, 2: 97, February, 1943.

[7] C. F. Craig, *Military Surg.,* 40: 286–302; 423–434, March–April, 1917.

[8] C. S. Swaminath, H. E. Shortt and L. A. P. Anderson, *Indian Jour. Med. Research,* 30, 3: 473–477, July, 1942.

NEMATODE PARASITES

Among the nematode parasites of man, we have endemic in this country the following species: *Ascaris lumbricoides, Necator americanus, Strongyloides stercoralis, Trichuris trichiura, Trichinella spiralis* and *Enterobius vermicularis.* While troops on foreign duty may be expected to acquire some of these parasites, the return of such infected individuals will make little difference in the status of these parasites here. On the other hand, some of our military operations are now being carried on in endemic areas of the Old World hookworm, *Ancylostoma duodenale,* and no doubt this infection will be brought back to this country. This species is somewhat more damaging than is *Necator americanus* and is more difficult to remove by anthelmintic treatment. However, the measures applicable to our present hookworm problem will be equally effective in controlling *A. duodenale.*

Filariasis. A nematode infection of more concern from a post-war standpoint is filariasis. This disease was once endemic in the region of Charleston, S. C., Guitéras[9] reporting the first case in 1886. Four years later De Saussure[10] recorded the finding of microfilariae in 22 cases of chyluria in persons born in Charleston. In 1915, Johnson[11] found 77, or 19.3 per cent., of 400 individuals representing routine admissions to Roper Hospital in Charleston to be infected with *Wuchereria bancrofti.* Francis[12] in 1919 examined 37 inmates of a home for the aged in Charleston and reported 13 positive for microfilariae. At the present time, Dr. Kenneth Lynch,[13] of the Medical College of the State of South Carolina, advises that this focus has practically died out.

It is difficult to fathom the circumstances which led to the establishment of filariasis at Charleston and not at other points in the Southern States, since the disease was no doubt introduced elsewhere by slaves from endemic areas in Africa. Perhaps an unusually large number of infected individuals was congregated at Charleston and conditions were extremely favorable for *Culex quinquefasciatus,* which Francis showed to be the intermediate host in that area.

A number of biological factors undoubtedly govern the spread of filariasis in any given locality. These factors include a high rate of infection in the locality, the occurrence in the blood stream of the infected individuals of an optimum number of microfilariae, the presence of a suitable mosquito host in numbers sufficient to provide an optimum rate of infection in this host, the accessibility of infected individuals to such mosquitoes and conditions of temperature and humidity suitable for the development of the microfilariae in the mosquito host.

While nothing is known concerning the infectibility of mosquito hosts in this country, other than that of *Culex quinquefasciatus,* many other suitable vectors undoubtedly occur in the continental United States. If a sufficient number of infected returning troops should be concentrated in areas in which intermediate hosts are prevalent, it is conceivable that filariasis might become reestablished in this country.

The matter of preventing such a circumstance is a difficult one. The period between infection and the appearance of microfilariae in the peripheral circulation is so long that infected individuals might be distributed over the country before the presence of their infection could be established while they were still in military service. Further, not all persons with microfilariae actually develop clinical symptoms, although, conversely, some with marked symptomatology may never show microfilariae.

The problem arises as to what disposition should be made of returning troops infected with *W. bancrofti* or *W. malayi.* Since there is no specific treatment for filariasis, there is no known way of destroying microfilariae in the blood stream, and therefore no method of sterilizing carriers. Furthermore, it would not appear feasible to retain these men in military service under quarantine conditions, since their infection might persist for years. Under these circumstances, a certain number of carriers will no doubt be distributed over the country. The probable number of such carriers is unpredictable. For this and other reasons, it is impossible to hazard a guess as to the opportunities for the reestablishment of the disease here. However, the seriousness of the disease and the potentialities of the situation warrant alertness on the part of public health officials. While awaiting further developments, we can at least secure additional information concerning mosquito vectors in this country and continue the search for a drug which will kill adult worms or one which will destroy microfilariae and sterilize female worms so that individuals carrying such worms will no longer serve as reservoirs of infection. Work on both of these problems has been going on in our laboratory for some time.

Onchocerciasis. This very serious parasitic disease occurs in a broad belt through Central Africa and in the Western Hemisphere in the States of Oaxaca, Chiapas and Guerrero, Mexico, and in certain departments along the Pacific Coast in Guatemala. The known vectors in the latter areas include three species of blackflies of the genus *Simulium.* We have little

[9] John Guitéras, *Med. News,* 48, 15: 399–402, April 10, 1886.

[10] P. G. De Saussure, *Med. News,* 56, 26: 704–707, June 28, 1890.

[11] F. B. Johnson, *Southern Med. Jour.,* 8, 7: 630–634, July 1, 1915.

[12] Edward Francis, *Hygienic Lab. Bull.* 117, Treasury Dept., Wash., June, 1919, 36 pp.

[13] Kenneth Lynch, personal communication.

to fear from the importation of the disease from Africa, but the situation to the south of us is of more concern.

The projected route of the Pan American highway will take the road through the endemic areas in Mexico and Guatemala. While at the present time, there is some movement of infected individuals from one country to another, particularly the movement of laborers on the coffee fincas, the whole region is a fairly inaccessible one. With the advent of the highway, we may expect the opening up of these previously inaccessible endemic zones with consequent migration of non-infected individuals into the zones and the expanded movement of infected persons out of the zones. Although some of the vectors occur outside of the infected zones, knowledge of their distribution is still very meager; furthermore, information is lacking concerning the infectibility of other species of *Simulium*. The fact that the microfilariae of *Onchocerca volvulus* penetrate the structures of the eye and lead to profound visual disturbances with eventual blindness in many cases makes the disease one of great importance from a public health standpoint. Because of the potentialities of the present situation, the Pan American Sanitary Bureau, under the direction of Dr. Hugh S. Cumming, in cooperation with the Republics of Mexico and Guatemala, is undertaking a coordinated program of laboratory and field studies with the view of developing measures effective for the control of the disease.

So far as our information goes, the known vectors of onchocerciasis do not occur in this country. However, Dyar and Shannon[14] listed 27 species of simuliids from the United States, and it is possible that some of these species might be biologically adapted to serve as intermediate hosts of the parasite. While the disease is still far from our borders, it will pay public health officials to keep a weather eye on the situation to the south of us.

CESTODE PARASITES

We already have in this country several species of tapeworms, including *Taenia saginata, T. solium, Echinococcus granulosus* and *Hymenolepis nana* and *diminuta*. *T. solium* has been something of a problem to British forces in India. Military personnel will no doubt be exposed to *Echinococcus* infection in such heavily infected areas as Iceland, New Zealand, Australia and the Mediterranean littoral. Dogs employed by the armed forces in these areas may acquire the infection and measures should be taken to examine such animals and properly treat infected ones before they are brought back to the United States. However, under the improved sanitation in slaughtering establishments in this country, hydatid disease has shown a steady tendency to decline, and it is not expected that our military campaigns abroad will contribute to the spread of infection here.

TREMATODE PARASITES

Our troops have already been exposed and will be further exposed to various trematode infections endemic in various parts of the world. Among the most serious of these trematode diseases are paragonimiasis, clonorchiasis and schistosomiasis.

Paragonimiasis. The oriental lung fluke, *Paragonimus westermanii,* is not a stranger to the United States, since it has been reported from the pig, dog, mink, muskrat, wildcat, domestic cat and goat on this continent. Strong[15] has stated that at least one case of human infection has been reported in North America. Ameel[16] found the operculate snail, *Pomatiopsis lapidaria* Say, to be the first intermediate host of the fluke in this country, and crayfish of the genus *Cambarus* to be the second intermediate hosts.

Cases of paragonimiasis have already been reported as having occurred in troops in certain areas and it is possible that the infection will be acquired by additional individuals. However, the importation of the fluke would seem to constitute no additional public health hazard. The infection has shown no tendency to spread to man in the United States and is not likely to do so since our people do not customarily consume raw crayfish.

Clonorchiasis. Clonorchis sinensis is distributed in various parts of the Sino-Japanese area. It has been brought into the United States frequently by immigrants from the Orient. In accordance with the Immigration Act of 1917, the Surgeon General of the United States Public Health Service classified clonorchiasis as a dangerous contagious disease, making mandatory the exclusion from admission to the United States of persons carrying this parasite.

During the following years, intensive investigations were carried out in California by Wayson[17] to determine whether there was any possibility of the parasite becoming established in this country. These experiments were entirely negative in so far as infection of domestic species of snails was concerned. Furthermore, epidemiological investigations carried on during the same period failed to disclose any autochthonous cases of clonorchiasis in California. So far as is known, no such cases have turned up since that time,

[14] Harrison G. Dyar and Raymond C. Shannon, *Proc. U. S. Nat. Museum,* 69, Art. 10: 1–54, 1927.

[15] Richard P. Strong, "Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases," 1747 pp. Sixth edition. Philadelphia: The Blakiston Company. 1942.

[16] Donald J. Ameel, *Am. Jour. Hyg.,* 19, 2: 279–317, March, 1934.

[17] N. E. Wayson, *Pub. Health Rpts.,* 42, 51: 3129–3135, December 23, 1927.

although eggs of *Clonorchis* are found occasionally in Orientals around San Francisco and in other parts of the state. In view of the above-mentioned facts, it is hardly conceivable that *Clonorchis* would become established here through the return of infected troops from abroad.

Schistosomiasis. At the present time our military forces are distributed in many endemic areas of schistosomiasis, including those in which *Schistosoma mansoni* and *S. haematobium* are present. Eventually we shall probably be campaigning in areas in which *S. japonicum* is endemic.

While several alleged autochthonous cases of schistosomiasis have been reported from the continental United States, the authenticity of most of these cases is open to serious doubt, and it is believed that they are based on mistaken diagnoses. At least, no case was acquired from domestic snails. In considering the possibilities for introduction into the United States of the three species of human schistosomes, a number of factors must be evaluated. Assuming that active cases occur among returning troops and that all these cases are not diagnosed and treated to the final conclusion in that the individuals will no longer be passing eggs of the parasite, we must consider whether the miracidia escaping from these eggs might reach snails and whether such snails might act as suitable intermediate hosts for the parasites.

Eggs given off into sewage systems would probably hatch, if temperature requirements were adequate, but nothing is known concerning the fate of these schistosome miracidia in sewage. Ordinarily, the miracidia are capable of active movement in water for a period of 16 to 32 hours but die after that time if they have not succeeded in reaching a suitable snail host. If sewage has no deterrent effect on the miracidia, it is conceivable that they might reach the treatment plant. If they were not sedimented out, they might be given off with the effluent and reach susceptible snail hosts, provided such snail hosts were available. It is not believed that chlorination of the effluent as commonly practised would be inimical to the miracidia, although more information is needed on the effect of chlorine on miracidia and cercariae.

Dangers of transmission of schistosomes to suitable snail hosts would be much more acute in rural areas in which feces or urine might be deposited in freshwater streams, ponds or lakes. The range of the human schistosomes lies within tropical and subtropical belts in low-lying areas characterized by slow-moving streams amply provided with vegetation, canals, irrigation ditches, marshes, swamps, freshwater ponds and smaller basins of accumulated rain water, conditions which are favorable for the snail intermediate hosts. Since schistosome parasites do not develop in snails under conditions of low temperature, warm climates provide most favorable conditions. Furthermore, the optimum temperature for hatching of ova lies between 25° and 30° C. All these conditions are present in many of our southern states.

In the presence of suitable intermediate hosts, the personal habits of the population in any given locality govern to a large extent the spread of schistosomiasis. For instance, Bettencourt, Borges and de Seabra[18] reported that at Tavira, Portugal, one of the few endemic areas on the European continent, it is the custom of the women to wash clothes in small ponds in which they also commonly urinate, the temperature of the water being favorable for the development of the snail hosts and for the hatching of the ova. In Puerto Rico, *S. mansoni* is confined mostly to parts of the island where there are slow-moving streams clogged with vegetation or where irrigation plays an important part in sugar cane production. The streams and irrigation canals are used for bathing and laundering, while most of the water for household purposes is obtained from the same sources. In endemic areas of *S. japonicum* in China, promiscuous defecation in canals and rice fields and the use of night soil as fertilizer contribute in an overwhelming manner to the perpetuation of the disease.

In the southern United States, where conditions would be most favorable for the establishment of schistosomiasis, the habits of the people are not comparable to those in most areas in which the disease continues to be an important problem. Probably only in exceptionally localized areas would conditions be optimum and circumstances sufficiently propitious for the propagation of the parasite.

However, there are in the United States 10 genera and 9 subgenera of snails of the family Planorbidae, and 12 of these 19 genera and subgenera occur in the southern states.[19] Some of these forms are related to species which are known to be good intermediate hosts of *S. haematobium* and *S. mansoni*. Other than *Helisoma lentum* reported by Faust and Hoffman[20] to be refractory to infection with *S. mansoni*, no experimental work has been done to determine whether these species of snails are susceptible to infection with these trematodes. Until proved to the contrary, it must be assumed that some of them at least might serve as carriers. Opportunities for the establishment of *S.*

[18] A. Bettencourt, I. Borges and A. de Seabra, La température de l'eau et la bilharziose a Tavira (Portugal). *Comp. Rend. Soc. Biol.*, 86, 6: 330–331, Fév. 11, 1922.

[19] The writer is indebted to Dr. Paul Bartsch, curator of molluscs and Cenozoic invertebrates, U. S. National Museum, Washington, D. C., for information concerning members of the family Planorbidae in the United States.

[20] Ernest Carroll Faust and William A. Hoffman, *Puerto Rico Jour. Pub. Health and Trop. Med.*, 10, 1, 1–97, September, 1934.

mansoni would appear to be far better than those in the case of *S. haematobium,* since the former has become established and has flourished in parts of the New World, whereas the latter, though probably repeatedly introduced in the same areas by the same means, has never been able to maintain itself. Further, planorbid snails in the continental United States are more closely related to those species carrying *S. mansoni* than they are to those carrying *S. haematobium.* In the case of *S. japonicum,* members of the genus *Tironius* in Utah and California might serve as intermediate hosts, although these forms differ somewhat in their biological requirements as compared to known carriers of this species.

To summarize the case for the schistosomes, we may conclude that there is a possibility of their establishment in the continental United States and that this possibility is more pronounced in the case of *S. mansoni.* This conclusion presupposes the occurrence of fortuitous circumstances involving large numbers of returning troops infected with the parasites, the concentration of considerable numbers of infected individuals into given areas, particularly rural areas in the southern states, where conditions would be most favorable for the propagation of the parasites, and the presence of suitable intermediate snail hosts.

Military authorities have already agreed to take such steps as are practical to limit the return of carrier cases to their home communities. In view of the lack of information on small hosts, the National Institute of Health is carrying on experiments to determine whether domestic species of planorbid snails can be infected with the various species of schistosomes. If such species are found, the situation would warrant extensive studies on the ecology and distribution of the incriminated forms.

THE INTRODUCTION OF DISEASE VECTORS

The catastrophic consequences of the introduction of *Anopheles gambiae* into northeastern Brazil are too well known to need reiteration. This circumstance, however, has served to emphasize to a marked degree the potential hazards with which the United States is faced in view of our accelerated world-wide air travel. The establishment of more efficient vectors of malaria in our present extensive endemic areas would be followed by disastrous effects on the welfare and economy of the South and might hinder tremendously our war effort. The introduction of exotic diseases by returning troops will render us even more vulnerable to any vectors which might be able to gain a foothold here. Needless to say, the United States Public Health Service is alert to all the potential possibilities in the situation and in cooperation with our military services is exerting every effort to guard our shores against the introduction of disease transmitting species.

One can not leave this general subject without calling attention to the need for training in tropical medicine on the part of public health workers and practising physicians. Our armed forces have done excellent work in better implementing service physicians through the inauguration of basic courses in tropical diseases. After the war is over many of these men will no doubt return to practise with an adequate background in this field and will be capable of diagnosing and treating cases of exotic disease which will come to them.

Likewise, a commendable effort has been made in providing more and better instruction in tropical medicine in our medical schools. Little has been done, however, in furthering knowledge of tropical diseases among physicians remaining in civil life and among public health workers who may be called upon to assume responsibility for the control of any such diseases which may be introduced as a result of our participation in the war. This latter problem would seem to lie within the sphere of influence of this association and might well serve as a subject for further discussion, planning and accomplishment.

OBITUARY

EDWARD BENNETT MATHEWS

DR. EDWARD BENNETT MATHEWS, emeritus professor of mineralogy and petrography at the Johns Hopkins University, died on February 4, 1944.

Dr. Mathews was born in Portland, Maine, on August 16, 1869. He received the bachelor's degree at Colby College in 1891, and was awarded the honorary degree of doctor of science in 1928 as one of its most distinguished alumni. The fact that his family was engaged in slate quarrying in Maine doubtless influenced his choice of a geological career, and led him to study mineralogy and petrography under George Huntington Williams at the Johns Hopkins University. He was awarded the degree of doctor of philosophy in 1894 and was immediately appointed instructor in mineralogy and petrography upon the untimely death of his eminent teacher. As field assistant in the U. S. Geological Survey from 1891 to 1894, he had served invaluable apprenticeships under another great teacher, C. R. Van Hise, in the Marquette district in Michigan, and under the renowned Whitman Cross and R. A. F. Penrose, Jr., in the Pike's Peak region in Colorado. Before beginning his teaching career, he also spent some time in Germany in the laboratory of another

of the great teachers of that day, Harry Rosenbusch. No more discriminating selection of teachers and geologists under whom to train could have been made. At the Johns Hopkins University, he was promoted to the rank of associate in 1895, to associate professor in 1899 and to professor in 1904. Upon the death of William Bullock Clark in 1917, he became chairman of the department of geology, which position he held until his retirement from active university duties at the age of 70 in 1939. None of his colleagues on the teaching staff served the university in more diverse capacities and with more unselfish devotion. He was especially helpful in planning the transfer of the university from down-town Baltimore to the outlying site at Homewood. No one had a greater store of information concerning persons and events in the history of the university.

Soon after the Maryland Geological Survey was established in 1896, he became assistant state geologist, and in 1917 he succeeded William Bullock Clark as state geologist, a position which he held until compelled to retire on account of ill health in 1943. Outside of his university teaching, the greater part of his geologic activity was devoted to the work of the Maryland Geological Survey. The excellent editorship and workmanship of the publications of that survey are mainly the product of his careful attention and his understanding of the arts of printing and engraving. His wide range of interests in many fields of knowledge was instrumental in giving to the publications of the Maryland Geological Survey an unusually wide scope which covered collateral and related fields beyond the customary limits of strictly geologic work. He was an important contributor to most of the volumes published by the survey from his "Bibliography and Cartography of Maryland in Volume 1, published in 1897, to the "Gazetteer of Maryland," published as Volume 14 in 1941. His contributions to the geology of Maryland covered such subjects as the petrography and structure of the piedmont, the building and ornamental stones, the limestones, the coals, the surface and ground waters, the mineral industries, the clays and the physical features. Keen interest in history, bibliography and cartography is reflected in such works as the "Bibliography and Cartography of Maryland," the "Catalog of Published Bibliographies in Geology," "The Counties of Maryland and their Origin," "Maps and Map Makers of Maryland," the report on the resurvey of the Mason and Dixon Line and the report on the location of the boundary line along the Potomac River between Maryland and Virginia. It was this sort of interest that led him throughout the years of his teaching to accumulate analyses of igneous rocks from all over the world, which culminated in the last years of his career as a Geological Society of America project under which he completed a search of geologic literature to assemble all existing analyses of igneous rocks and arrange them geographically by latitude and longitude and by classes. It is to these same interests in history, bibliography and cartography that the department of geology of the Johns Hopkins University owes its excellent geologic library which is so rich in classical and foreign literature and its large collection of foreign maps. The people of the State of Maryland have benefited from his love of cartography through the many useful maps published by the Maryland Geological Survey. Maryland is perhaps the only state provided with county topographic maps of all its counties. Under his direction, the Survey has also published soil maps of all the counties on the topographic base. In addition geologic maps of nearly all the counties have been published and forestry maps of a number of the counties. Other much-used maps prepared by Dr. Mathews are various types of general maps of the state and two editions of a geological map of the state. He also prepared large-scale maps of the principal cities of the state. Especially useful in building projects and public works are his maps of Baltimore City showing respectively the original shore lines and drainage, the configurations of the underlying rock floor and the amount of overburden covering the underlying rock. One of his fellow state geologists in appraising his work closed with the tribute, "He lived a long and fruitful life and Maryland has many things to thank him for."

Dr. Mathews not only served his adopted state as State Geologist, but in many other capacities. He was director of the Maryland Weather Service from 1917 to 1933, executive officer of the State Board of Forestry from 1917 to 1925, member of the Maryland State Development Commission since 1929, member of the Water Resources Commission from its establishment in 1933 until it was merged in 1941 with the Maryland Geological Survey into the Department of Geology, Mines and Water Resources, of which he became director, and member of the Board of Natural Resources since its establishment in 1941. He was also, since 1914, secretary of the Maryland Historical Society Library.

Outside of Maryland, he served for many years as chairman of the advisory council of the U. S. Board of Surveys and Maps, as chairman of the Division of Geology and Geography of the National Research Council from 1922 to 1925, as vice-president and treasurer of the Sixteenth International Geological Congress, and as treasurer, member of the finance committee and councilor of the Geological Society of America since 1917. He was also president of the American Association of State Geologists from 1921

to 1923 and vice-president from 1918 to 1920, 1924 to 1925, and 1930.

His wide human interests and love of geography made him an eager traveler and student of the classic geologic areas of Europe and other parts of the world, experiences that greatly enriched his knowledge of geologic history, places and persons. This wealth of knowledge and experience he was ever ready to share with friends, colleagues and students, who found him an unending and never-failing source of information.

The stimuli to such a wide range of activities and interests were an innate intellectual curiosity and an unselfish desire to be useful to others, and never an urge to display unusual wisdom or to bring himself into the forefront. He adroitly avoided public and formal exhibition of the versatility and range of his knowledge and experience, but he was always ready and happy to share their fruits unobtrusively and informally in friendly conversation. The character and personality of Dr. Mathews can not be more appropriately described than in the words of a colleague of long association who said, " I have never known him to do an unkind or unfair act" and of another fellow geologist who wrote, "All of us who knew Professor Mathews personally had a real affection for him and we had a deep appreciation of his able and unselfish devotion in his chosen field. We shall greatly miss him."

JOSEPH T. SINGEWALD, JR.

RECENT DEATHS

PROFESSOR WILLIAM EDWARD TOTTINGHAM, associate professor of biochemistry at the University of Wisconsin, died on March 2. He was sixty-two years old.

DR. FREDERIC WILLIAM SCHLUTZ, Richard T. Crane professor of pediatrics and chairman of the department at the University of Chicago, died on March 9 at the age of sixty-three years.

DR. HELEN COPELAND COOMBS, instructor in physiology at Brooklyn College, died on March 4 at the age of fifty-two years.

THE death is announced of Dr. H. F. Newall, F.R.S., from 1909 until his retirement with the title emeritus in 1928 professor of astrophysics at the University of Cambridge.

DR. JOHN WILLIAM HENRY EYRE, emeritus professor of bacteriology at the University of London, died on February 17 in his seventy-fifth year.

SCIENTIFIC EVENTS

CHINESE SCIENTIFIC SOCIETIES

IN an account of the joint annual meeting held last July of scientific societies in China, including the zoological, the botanical, the meteorological, the mathematical and the geographical societies, under the presidency of Dr. Wong Wen-Hao, *Nature* reports that Dr. Joseph Needham, Sir William Dunn reader in biochemistry at the University of Cambridge, England, was elected an honorary member of the Science Society of China, in appreciation of "his distinguished academic work and his service in promoting cooperation between Chinese and Western science, which had been so effectively carried on during the previous six months."

The six societies spent two mornings in communicating original papers dealing with their respective sciences; more than three hundred papers were read. Brief abstracts of these papers will be published shortly in Chinese with additional English titles.

One of the two remaining afternoons was devoted to a discussion on "Science and National Reconstruction," with special reference to the problem of how science is to be promoted in China. Opinions were formulated on the following four points, which were presented to the Chinese Government for immediate adoption.

(1) The government is requested to provide a large fund in the forthcoming national budget for, and only for, the furtherance of scientific research and of the scientific education of the masses.

(2) The personnel and equipment of the leading science institutes, such as those of Academia Sinica, must be materially augmented.

(3) The government must endeavor to establish cooperation between the scientific workers on the one hand and officials in charge of national planning on the other, so that the resulting plans may be more practical and fruitful.

(4) While the government is considering sending a large number of young men of science abroad, it is deemed appropriate that such opportunities should be extended to mature scholars also. Here again, the government is requested not to neglect pure science in favor of applied sciences and technology. There was a discussion on "International Science Cooperation," and an address by Dr. Needham entitled "International Science Cooperation in War and Peace" was read by Dr. H. C. Zen, president of the Science Society of China. A scientific exhibition intended for the general public was arranged.

ADVANCED INSTRUCTION AND RESEARCH IN MECHANICS AT BROWN UNIVERSITY

BROWN UNIVERSITY has issued an announcement of the program of advanced instruction and research in mechanics, covering the period since its inauguration

in June, 1941, through the summer of 1944. To provide instruction for men and women who are urgently needed for basic work in mechanical engineering and allied branches of industry, a faculty eminent in the applications of advanced mathematical theory has been serving for eight terms in this program, which is under the auspices of the U. S. Engineering, Science and Management War Training, with liberal support from the Carnegie Corporation and the Rockefeller Foundation.

A recent compilation has shown that from this program more than sixty students have entered on research in mathematics, physics and engineering for government agencies and that twenty-five are serving similarly in war industries. While it was originally expected that students would remain for three or four years and proceed to the doctorate, in the emergency men have taken up useful research after fifteen months of training beyond the baccalaureate.

In addition to the regular instruction given, activities have included

(1) two conferences, one on Non-Linear Vibrations and the other on Exterior Ballistics; (2) fifty-five special lectures by authorities in related fields; (3) the inauguration of a new journal, the *Quarterly of Applied Mathematics*, (4) the publication of twenty research papers by students and the preparation of as many other confidential reports; (5) the preparation of two advanced treatises for printing and the mimeographing and distributing of eleven others; (6) research at Brown University for various government agencies connected with the war.

The Advisory Committee consists of Dr. Thornton C. Fry, mathematical research director, Bell Telephone Laboratories; Marshall H. Stone, professor of mathematics, Harvard University; Theodore Theodorsen, chief of the physical research division of the National Advisory Committee for Aeronautics, Langley Field. The Board of Editors of the *Quarterly of Applied Mathematics* consists of H. L. Dryden, J. M. Lesells, T. C. Fry, W. Prager, J. L. Synge, Th. v. Kármán, I. S. Sokolnikoff; it is assisted by an equally eminent international Board of Collaborators.

The progress made by America in the physical sciences and in the practical aspects of engineering since the turn of the century almost outruns the imagination. But, as was pointed out by Thornton C. Fry in the 1940 report to the National Resources Planning Board, there are some sectors in which we have lagged. We have not kept pace with mathematics fundamental to the development of new industries, such as aircraft manufacture; other countries have ranged dangerously ahead of us. In order that the nation forge ahead in war or in peace, there is need for a more intensive cultivation of the theoretical aspects of some branches of mechanical and electrical engineering. The deficiency is in part due to the paucity of university courses for the graduate training of industrial mathematicians. In part also it is due to a fundamental attitude of the American public which is suspicious of theory. The nation has relied on practical and experimental methods for solving problems; we see this in government as well as in engineering. In a democracy this attitude is attended with grave dangers, for it does not have within itself the seed for its own correction. Some extraordinary means must from time to time be found to bring the necessities of the case home to those with influence in making policies.

These were some of the considerations which occasioned the inauguration at Brown University of the program a few months before war came to America. For the twelve weeks Summer Session of 1944, beginning on June 12, a series of ten courses has been scheduled. On the faculty for the summer are S. Bergman, L. Bers, W. Feller, D. L. Holl, W. Hurewicz, R. K. Luneberg, W. Prager, J. D. Tamarkin and one other still to be chosen. In addition there will be a series of special lectures. No tuition fees are charged; small stipends to cover living expenses are available for some specially qualified persons. A prerequisite is an undergraduate major in mathematics, physics or engineering performed with distinction. The number of participants will be limited to seventy-five. Inquiries may be directed to the Dean of the Graduate School, Brown University, Providence 12, R. I.

R. G. D. RICHARDSON

SCIENTIFIC INSTRUMENTS NEEDED

REQUESTS for instruments urgently needed for essential war work have been received by the Committee on Location of New and Rare Instruments. Any one having any of the following instruments, willing to sell, rent, lend or give them for necessary work, will perform a service by informing D. H. Killeffer, Chairman, 60 East 42nd St., New York 17, N. Y.

Weston Ammeter #622 (0–100 ma)
Weston Ammeter #280 (0–50)
Surface Tension Balance
Precision Cathetometer 32″ Range .003″ error
Babinet Compensator (Soleil)
High Speed Impulse Counter (Cenco #73506 or #73511)
Amsler #4 Integrator
Gas Interferometer (Zeiss or Hilger) (several)
G. E. or Esterline Angus Recording Milliammeter Spring Drive 0–5 ma 6″12″/min speed
Beckman Industrial Model M or Coleman Model 3A pH meter
Weston Microammeter
#643 100 scale div. Res 385 ohms.
#741 100 scale div. Res. 1110 ohms.

Potentiometer—L & N 8660
Potentiometers (type K or other) (several)
(Moderately high or quite high sensitivity)
Campbell Shackelton Shielded A.C. Ratio Box
(Equivalent to L & N A.C. Ratio Box 1553)
Abbe Refractometer (several)
Spectrotelephotometer (Cenco-Sherd)
Quartz Spectrograph
Strobotacs (Genl Radio 631-B)
Stroboscopic equipment
Western Electric Electrometer Tube D-96475
Tinius-Olson Stiffness Testing Machine. Cat. #932
G. E. X-ray Diffraction Unit
Recording Oscillograph (Minimum Sensitivity) (several channels capable of recording one hour at one inch per second. Suitable for aircraft operation.)

A WESTINGHOUSE RESEARCH GRANT TO PURDUE UNIVERSITY

G. STANLEY MEIKLE, research director of the Purdue Research Foundation, and A. A. Potter, dean of the Schools of Engineering, announce the establishment at Purdue University of a project for the "intensive training of graduate students in exploring the field of heat transfer for data upon which many of the practical developments of the future depend." The project was made possible by a grant of $75,000 from the Westinghouse Electric and Manufacturing Company. Dr. George A. Hawkins, professor of mechanical engineering at Purdue University, who has been appointed Westinghouse research professor in heat transfer, will conduct a five-year program for training and research.

Dr. Max Jakob, of the Illinois Institute of Technology, will cooperate with Dr. Hawkins in the capacity of non-resident research professor. Research associates to be known as fellows will be appointed. For their experiments they will have access to the heat transfer laboratory of the School of Mechanical and Aeronautical Engineering. Facilities will be provided also in other departments of the university.

According to the official statement, Director Meikle stressed the importance of advanced student training and research in this field. He described the undertaking as "contributing to the liberalization of the mechanic arts in response to the demand for enlightenment relative to industrial development. It is believed that education and industry are logical participants in the aggressive and balanced development of four major concerns which confront the executives and scholars of a university. These are the conservation of knowledge and ideas; the interpretation of knowledge and ideas; the search for truth, and the training of students who will continue to practice its teachings and carry on its work in the everyday contacts with life's problems."

M. W. Smith, vice-president of the Westinghouse Electric and Manufacturing Company in charge of engineering, said:

The Westinghouse grant is the latest step in the company's broad educational program which, in cooperation with the nation's universities and colleges, encourages scientific education and research. Annually, the company awards scholarships and fellowships and contributes to the support of research and special educational activities in the belief that knowledge thus gained helps all industry.

NOMINATIONS FOR OFFICERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

THE national nominating committee of the American Institute of Electrical Engineers, consisting of members from various parts of the country, has nominated the following official ticket of candidates for the offices becoming vacant on August 1, 1944:

For *President:* C. A. Powel, manager of the Headquarters Engineering Departments of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

For *Vice-presidents:*

(North Eastern District)—R. T. Henry, assistant chief electrical engineer, engineering department, Buffalo, Niagara and Eastern Power Corporation.

(New York City District)—J. F. Fairman, assistant vice-president, Consolidated Edison Company of New York.

(Great Lakes District)—M. S. Coover, professor and head of department of electrical engineering, Iowa State College.

(South West District)—R. W. Warner, professor and head of department of electrical engineering, University of Texas.

(North West District)—C. B. Carpenter, assistant chief engineer, Oregon Area, Pacific Telephone and Telegraph Co., Portland.

For *Directors:*

P. L. Alger, staff assistant to vice-president in charge of engineering, General Electric Co., Schenectady.

M. J. McHenry, director of sales promotion, Hydro-Electric Power Commission of Ontario, Toronto.

D. A. Quarles, director of transmission development, Bell Telephone Laboratories, New York.

For *National Treasurer:* W. I. Slichter, professor emeritus of electrical engineering, Columbia University.

These official candidates, together with any independent nominees that may be proposed later, will be voted upon by the membership at the coming election this spring.

H. H. HENLINE,
National Secretary

SCIENTIFIC NOTES AND NEWS

A DINNER in honor of the eighty-fifth birthday of Dr. William F. Durand, emeritus professor of mechanical engineering at Stanford University, was given by his friends on March 4 in Washington. He was presented with the "W. F. Durand Anniversary Volume" which contains papers selected from those he had already presented before societies in the fields of aeronautics, mechanical engineering, naval architecture and marine engineering.

GLEN DAVID BAGLEY, head of the research division of experimental engineering of the Union Carbide and Carbon Corporation, has been awarded the Jacob F. Schoellkopf Medal for 1944 by the Western New York Section of the American Chemical Society, in recognition of "outstanding and highly significant work, particularly in the fields of the commercialization of very active metals." He is the fourteenth recipient of the medal.

PRESENTATION of the William H. Nichols Medal of the New York Section of the American Chemical Society for 1944 was made on March 10 to Dr. Carl S. Marvel, professor of organic chemistry at the University of Illinois, president-elect of the society. The medal was awarded in recognition of "outstanding organic chemical contributions to the structure of polymers."

THE three hundred and twenty-fifth meeting on March 16 of the Washington Academy of Sciences was devoted to the presentation of its awards for scientific achievement for 1943 as follows: For the *Engineering Sciences,* to Lloyd V. Berkner, physicist of the Department of Terrestrial Magnetism of the Carnegie Institution, Commander, U.S.N.R., in recognition of his distinguished service in research on the ionosphere and wave propagation; for the *Biological Sciences,* to Jason R. Swallen, associate botanist of the Bureau of Plant Industry, Office of the Coordinator of Inter-American Affairs, in recognition of his distinguished service in agrostology, and for the *Physical Sciences* to Dr. Lawrence A. Wood, chief of the rubber section of the National Bureau of Standards, in recognition of his distinguished service in the investigation of rubber and other high polymers.

LIEUTENANT COLONEL NORMAN I. ADAMS, associate professor of physics at Yale University, received on March 9 from the War Department the award of the Legion of Merit. The presentation was made at a ceremony which took place at the university. The citation reads: "Colonel Adams displayed initiative, imagination and high technical proficiency in solving diverse and difficult problems under his jurisdiction, and in a very superior manner conducted research and development in the broad field of physics which resulted in the rapid completion of equipment for the Field Artillery, Army Air Forces and Signal Corps."

DR. HATTIE ALEXANDER, associate professor of pediatrics at Columbia University, is the recipient of the $500 prize given annually under the auspices of the American Academy of Pediatrics by Mead Johnson and Company for "outstanding scientific contributions to pediatrics in the United States." The award was made "in recognition of her work on the treatment of hemophilus influenzae meningitis."

THE Council of the British Institution of Naval Architects has awarded the premium of the institution for the year 1943 to Dr. J. F. C. Conn for his paper entitled "Marine Propeller Blade Deflection."

DR. HARRY R. RICARDO, consulting engineer, has been elected president of the British Institution of Mechanical Engineers.

THE officers of the American Microscopical Society elected for the year 1944 are: *President,* C. E. Allen, University of Wisconsin; *First Vice-president,* W. A. Hilton, Pomona College; *Second Vice-president,* A. H. Wiebe, Tennessee Valley Authority; *Secretary,* J. E. Ackert, Kansas State College; *Treasurer,* A. M. Chickering, Albion College; *Elective Member of Executive Committee,* L. L. Woodruff, Yale University; *Members on the Council of the American Association for the Advancement of Science,* J. E. Ackert and A. M. Chickering.

DR. RAYMOND C. OSBURN, from 1917 to 1942 professor of zoology and entomology and head of the department at the Ohio State University, and Dr. W. W. Charters, professor of education and director of educational research, have retired with the title emeritus.

DR. J. ALLEN SCOTT, senior statistician in the division of vital statistics of the U. S. Bureau of the Census, previously associated with the Rockefeller Foundation in Egypt, has been appointed associate professor of preventive medicine in the field of statistics and epidemiology at the School of Medicine at Galveston of the University of Texas.

DR. DUANE ROLLER, formerly professor of physics at Hunter College, New York, and since 1941 a chief technical aid to the Armor and Ordnance Division of the National Defense Research Committee, has joined the faculty of Wabash College as head of the department of physics. Associate Professor Joseph D. Elder, of the department of physics of Lynchburg College, Virginia, also has become a member of the department.

THE American Public Health Association announces the appointment of Professor C.-E. A. Winslow, Anna M. R. Lauder professor of public health at Yale University, as editor of *The American Journal of Public Health* to succeed Dr. Harry Stoll Mustard, professor of public health practice at the College of Physicians and Surgeons of Columbia University and director of the DeLamar Institute of Public Health.

DR. WILLARD C. RAPPLEYE, dean of the College of Physicians and Surgeons of Columbia University, has been reelected chairman of the Research Council of the Department of Health, New York City. Other officers reelected are Dr. Edward M. Bernecker, commissioner of hospitals, *vice-chairman;* Dr. Alfred E. Cohn, of the Rockefeller Institute for Medical Research, *treasurer,* and Dr. Walter G. Lough, president of the medical board of Goldwater Hospital, *secretary.*

CLYDE E. WILLIAMS, director of the Battelle Memorial Institute at Columbus, Ohio, has been engaged as a technical consultant by the Association of American Railroads. His headquarters will be in Chicago.

DR. MARVIN R. THOMPSON, director of the Warner Institute for Therapeutic Research, vice-president of William R. Warner and Company, Inc., of New York and St. Louis, manufacturers of pharmaceutical products, has been appointed president of the company. Previously he had been pharmacologist and later consultant pharmacologist of the U. S. Food and Drug Administration, associate professor of pharmacology at George Washington University and professor of pharmacology at the University of Maryland.

OWING to a misplacement of lines, under "Scientific Events," on page 139, in the issue of SCIENCE for February 18, it was not made clear that H. C. Diehl, principal chemist and chief of the commodity processing division of the Western Regional Research Laboratory of the U. S. Department of Agriculture, and not Dr. Samuel C. Prescott, had been appointed director of the Refrigeration Research Foundation with headquarters at Berkeley, Calif. In addition to his post as director Mr. Diehl will also serve as secretary for general and scientific business.

IT is reported in *Nature* that Dr. E. F. Armstrong has been appointed chairman of a commission appointed by the Conference of Allied Ministers of Education to report on the problems involved in the supply of scientific equipment to the occupied countries when they have been freed.

THE British Medical Research Council has established a unit for research in human nutrition as part of its staff organization, and has appointed Dr. B. S. Platt as director. Temporary accommodation has been provided at the National Hospital for Nervous Diseases, London. Some part of the investigations undertaken by the unit will be directed towards nutrition problems in the tropics. Dr. Platt will continue the work, for which he joined the staff of the council in 1938, of coordinating a program of nutritional investigations in the colonies.

DR. WILLIAM J. ROBBINS, director of the New York Botanical Garden, addressed the Alpha Lambda Chapter of Beta Beta Beta at Hofstra College on March 3. His address was entitled "What Plants Mean to the World."

HAROLD A. SWANSON, manager of the Patent Department of the National Oil Products Company, Harrison, N. J., spoke on "Patents and the Chemist" at a dinner meeting on March 17 of the New York Chapter of the American Institute of Chemists.

THE American Museum of Natural History has completed reorganization of its exhibition hall of Mexican and Central American Archeology and the new and modernized exhibits were opened to the public on February 26. A private preview of the hall was held on the evening of February 25. It was attended by representatives of Mexico and Central American countries and by trustees and friends of the museum. His Excellency, Dr. Francisco Castillo Najera, the Mexican Ambassador, Dr. Archibald MacLeish, Librarian of Congress, and Dr. Harry L. Shapiro, chairman of the department of anthropology, were the principal speakers on the program. A. Perry Osborn, acting president of the museum, presided, and the address of welcome was made by Dr. Albert E. Parr, director of the museum. Cooperating with the museum on this occasion was the coordinator of Inter-American Affairs and the Pan American Society of the United States.

A BUILDING for the new Medical College of the University of Alabama will be erected at Birmingham. A million dollars for land, buildings and equipment have been appropriated and in addition the sum of $366,750 for the fiscal years ending on September 30, 1944, and on September 30, 1945.

THE School of Medicine of Louisiana State University has received a special appropriation of $36,000 from the Board of Supervisors for the expansion of its library. These funds will be used for purchasing sets of periodicals.

THE Rockefeller Foundation has made an appropriation of $7,500 as a contribution to be used under the direction of Professor F. F. Nord in connection with his researches in enzyme chemistry at Fordham University.

A GRANT of $4,000 from Wallace and Tiernan Company, New York City, to pay for the cost of research

on the sterilization of swimming pools, has been made to the Michigan State College at East Lansing.

PLANS have now been completed whereby the American Society for Metals will provide an annual fund of $1,000 for the support of research in the field of corrosion. The American Coordinating Committee on Corrosion has been designated to receive and approve applications for grants from this fund. A subcommittee on research has been appointed under the chairmanship of Dr. R. M. Burns, assistant chemical director of the Bell Telephone Laboratories, New York, N. Y. Other members are T. S. Fuller, of the General Electric Company; Dr. F. W. Adams, of the Pittsburgh Plate Glass Company, and Dr. H. L. Maxwell, of the E. I. du Pont de Nemours Experiment Station. The committee will select such research projects as appear worthy of support, will approve the qualifications of applicants for grants-in-aid from the research fund, and will certify to the American Society for Metals the names of successful applicants. The grants-in-aid will vary from $250 to $1,000.

THE Williams and Wilkins Company has announced the establishment of the Passano Foundation "for scientific and educational purposes, particularly to provide for scientific research and to publish the results of scientific research and to make awards for meritorious achievements in scientific research." By the terms of the charter the board of directors may inaugurate the establishment of "an annual award not to exceed $5,000 for an outstanding contribution by an American citizen to the advancement of medical science made within the year." The directors include Dr. Emil Novak, associate in gynecology at the Johns Hopkins University Medical School, and Dr. George Corner, director of the Embryological Laboratory of the Carnegie Institution of Washington. E. B. Passano is chairman of the board and Robert S. Gill is president.

IT is planned to establish at the University of Oxford a center for research and postgraduate study for the prevention of blindness and the better treatment of diseases of the eye. The Ophthalmological Research Endowment Committee, of which Sir William Goodenough is chairman, plans to raise £250,000 for the purpose. So far about £26,000 towards the founding of a department of ophthalmology has been collected.

DISCUSSION

PURIFICATION AND ANTIBACTERIAL ACTIVITY OF FUMIGACIN AND CLAVACIN

THE rapid progress that is being made at the present time in the study of antibiotic substances produced by microorganisms can best be illustrated by an examination of the results of recent investigations of two mold products, fumigacin and clavacin. In the eighteen months that have elapsed since the first announcement[1] of the production of these two substances by two groups of fungi, *Aspergillus fumigatus* and *Aspergillus clavatus*, respectively, they have been crystallized and their chemical nature determined. Moreover, each has been described under different names, and one has been found to be produced by several different groups of fungi. In order to avoid further confusion in the characterization of these two chemical compounds, a brief summary of the results thus far obtained is justified.

Fumigacin was originally described[2] as a substance produced by a number of strains of *A. fumigatus*, as containing a small amount of nitrogen, as active largely against gram-positive bacteria and as characterized by appreciable toxicity to animals. Menzel, Wintersteiner and Hoogerheide[3] demonstrated that fumigacin prepared from *A. fumigatus* by the method of Waksman, Horning and Spencer[2] contained 20 per cent. gliotoxin, a substance high in nitrogen and in sulfur[4] and appreciably toxic to animals; when the gliotoxin fraction was removed, the purified fumigacin was found[3,5] to retain its original antibacterial activity, was free from nitrogen, and possessed only a limited toxicity to animals. Unaware of these findings, a group of British workers[6] isolated the same substance from a strain of *A. fumigatus* and described it as helvolic acid. This preparation proved to be identical with the purified fumigacin in chemical composition, in antibacterial activity and *in vivo* activity. Helvolic acid must, therefore, be considered as identical with fumigacin.

Clavacin was originally prepared[2] only in crude form. It was reported to be active against a variety of bacteria found among both the gram-positive and the gram-negative groups, and was highly toxic when

[1] S. A. Waksman, E. Horning and E. L. Spencer, SCIENCE, 96: 202–203, 1942.

[2] S. A. Waksman, E. Horning and E. L. Spencer, *Jour. Bact.*, 45: 233–248.

[3] A. E. O. Menzel, O. Wintersteiner and J. C. Hoogerheide, *Jour. Biol. Chem.* In press.

[4] J. R. Johnson, W. F. Bruce and J. D. Dutcher, *Jour. Amer. Chem. Soc.*, 65: 2005–2009, 1943.

[5] S. A. Waksman and W. B. Geiger, *Jour. Bact.* In press.

[6] E. Chain, H. W. Florey, M. A. Jennings and T. I. Williams, *Brit. Jour. Exp. Path.*, 24: 108–119, 1943.

injected into the animal body, 3.5 mg being lethal per kilogram of body weight.[7] Recently, two contributions appeared dealing with the isolation and crystallization of clavacin from two kinds of fungi, *Penicillium patulum*[8] and *A. clavatus;*[9] both preparations proved to be identical chemically. A comparison of the respective antibacterial spectra, as announced for the crude clavacin[10] and for patulin[8] (the name given to the substance isolated from *P. patulum*), and as found for crystalline clavacin[11] further established the fact that the two substances are identical. The crystalline clavacin was found to be less toxic to animals than crude clavacin,[11] its activity being in this respect, as well, identical with that reported for patulin.[8]

As this note was being written, an article appeared[12] dealing with the identity not only of clavacin and patulin, but also of claviformin, a substance produced by *P. claviforme;*[13] the authors,[12] believing that they were the first to crystallize clavacin, proposed a new name for this substance, namely, clavatin. It may be of interest to record here that clavacin, as first announced,[1] possessed quantitatively all the antibacterial properties of the crystalline preparation, thus pointing to the fact that it was in a nearly pure, even though non-crystalline, state. The isolation of claviformin was announced simultaneously with that of clavacin. Furthermore, the claviformin preparation contained a small amount of sulfur, and the wrong chemical formula was suggested for it ($C_9H_8O_5$). Comparative data for the various preparations are brought out in Table 1.

These results definitely indicate that the five preparations are identical in their chemical nature and antibacterial activities (slight quantitative differences in activity may be due to the use of different strains of test organisms). Whatever may be the final decision concerning the proper designation of this substance, the fact remains that three different organisms, *A. clavatus, P. claviforme* and *P. patulum,* produce the same antibiotic substance.

It is thus important to record here that considerable confusion has arisen from the fact that various microorganisms are capable of producing the same type of antibiotic substance. This has already been demonstrated for the following: citrinin is formed by *P. citrinum* and *A. candidus;* penicillic acid, by *P. puberulum* and *P. cyclopium;* penicillin, by *P. notatum, P. chrysogenum* and *A. flavus;* gliotoxin, by *Trichoderma, Gliocladium* and *A. fumigatus;* spinulosin, by *P. spinulosum* and *A. fumigatus;* and clavacin by *P. claviforme, A. clavatus* and *P. patulum.*

For the sake of completeness, it should also be mentioned that much confusion in the study of antibiotic substances has arisen from the fact that many organisms are capable of producing more than one type of substance. It is sufficient to call attention to the confusion that has arisen from the designation of the second antibacterial factor produced by *P. notatum,* namely, the glucose-oxidase, which has been designated as *E. coli* factor, penatin, notatin and penicillin B, and which has often been confused with the true penicillin. *A. fumigatus,* however, apparently tops the list, since it has the capacity of forming four different antibacterial compounds, spinulosin, fumigatin, fumigacin and gliotoxin, the first two of which are closely related.

TABLE 1

Name of preparation	When announced	Empirical formula	Melting point °C	Antibacterial activities	
				E. coli units	*S. aureus* units
Clavacin, non-crystalline	Aug. 20, 1942[1]	.....	.....	165,000–230,000[10]	100,000–200,000[10]
Claviformin	Aug. 1942[13]	$C_7H_6O_4$	110	80,000	160,000
Patulin	1943[8]	$C_7H_6O_4$	111	33,000–50,000	33,000–50,000
Clavacin, crystalline	Jan. 7, 1944[9]	$C_7H_6O_4$	109–110	200,000–250,000[11]	200,000[11]
Clavatin	Dec. 25, 1943[12]	$C_7H_6O_4$	109.5–110.5	.....	64,000–128,000

[7] H. Robinson, Some toxicological, bacteriological and pharmacological properties of antimicrobial agents produced by soil microorganisms. Thesis. Rutgers Univ., 1943.

[8] H. Raistrick, J. H. Birkinshaw, S. E. Michael, A. Bracken, W. E. Gye and W. A. Hopkins, *Lancet,* 245: 625–635, 1943.

[9] I. R. Hooper, H. W. Anderson, P. Skell and H. E. Carter, SCIENCE, 99: 16, 1944.

[10] S. A. Waksman and A. Schatz, *Proc. Nat. Acad. Sci.,* 29: 74–79, 1943.

[11] Unpublished data.

[12] F. Bergel, A. L. Morrison, A. R. Moss, R. Klein, H. Rinderknecht and J. L. Ward, *Nature,* 152: 750, 1943.

[13] E. Chain, H. W. Florey and M. A. Jennings, *Brit. Jour. Exp. Path.,* 23: 202–205, 1942; see also recent note in *Lancet,* 246: 112–114, 1944.

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A LAST WORD ON "STARRING"

I HAVE read with interest Dr. F. C. Whitmore's remarks in SCIENCE for November 26, 1943, on "starring," but was somewhat surprised to note how far he has strayed from the original meaning of this distin-

guishing mark for certain men of science. According to Dr. J. McKeen Cattell in the preface of the first edition of "American Men of Science" (January, 1906), "the star means that the subject of the biographical sketch is probably among the leading thousand students of science of the United States." This meaning has been followed in succeeding editions of "American Men of Science" and it is specifically stated in the caption of the last voting list, which reads: "Chemists nominated for inclusion among the one hundred and seventy-five leading chemists in the United States."

Dr. Whitmore, however, interprets starring somewhat differently. He speaks of the large loss of leading chemists by some institutions which has caused them "to encourage the younger members of the chemistry staff and to add to that staff young men of promise" and then refers later to "a chance of the accidental omission of the name of a deserving young scientist by the group which makes the preliminary nominations." Now this emphasis placed by Dr. Whitmore on youth is lacking in the caption of the voting list which does not read "one hundred and seventy-five deserving young chemists of promise" but "one hundred and seventy-five leading chemists." Youth, of course, must be served, but it is a far leap from the status of a "young chemist of promise" to that of a "leading chemist." The young chemists of promise may eventually become leading chemists, and it is hoped that they will, but until they are so recognized their names should not be placed on a ballot intended solely for leading chemists. The inclusion of their names on such a list means the exclusion of the names of older, better known chemists with greater records of accomplishments.

We should feel indebted, however, to Dr. Whitmore for having disclosed what seems to have been the guiding motive of some institutions in making up the list of their nominees. The insertion of the names of young men by an institution on a voting list along with the names of older scientists involves a lowering of the average production rating of its entire group of nominees; the young men, however promising, haven't had the time to produce. An easily determined, although not wholly satisfactory, index of productivity is the number of papers published during a certain period of time. It is open to several objections but is free from bias and vastly better than basing one's judgment on mere acquaintance, or hearsay evidence, or solicitation, or preference for the members of a particular college. It is useful as a rough, convenient measuring stick and was so applied to the nominees of the two institutions with the highest number of candidates on the last voting list, as summarized in my paper in SCIENCE for September 24, 1943.

For the institution with 8 nominees the following number of papers, of which a candidate was author or co-author, according to the last Decennial Index of Chemical Abstracts, was found to be, respectively: 82, 25, 24, 21, 21, 12, 9, 3—a total of 197, or an average of 24.6 per man. Five of the nominees had published more than 20 papers, which speaks well for the chemical productivity of this institution. The average age of these five candidates, according to "American Men of Science," was 48 years; the average age of the nominees who had published less than 20 papers was 38 years. This institution seems to have placed a little greater stress on men of productivity. The other institution with 7 nominees on the voting list showed the following records. Number of papers published per individual for the same decennial period: 59, 14, 12, 3, 2, 2, 1—a total of 93, or an average of 13.3 per man. The age of the nominee with 59 papers was 53 years; the average age of the remaining candidates who had published less than 20 papers was 36 years. This institution, in making up its list, seems to have placed stress almost entirely on young men of promise. A number of institutions, represented on the voting list with only a few nominees, seem to have concentrated almost wholly on men of productivity. One university with only 3 candidates had a total productivity of 112 papers, or an average of 37 papers per man. As to how far older chemists of high productivity may possibly be exposed to "a chance of the accidental omission," referred to by Dr. Whitmore, the single example is cited of a prominent institution that has 8 excellent "unstarred" chemists of an average age of 55 years who for the same decennial period published 279 papers or an average of 35 per man. Not one of their names appears on the last list of chemists nominated for "starring."

The future of the practice of "starring" men of science would seem, therefore, to depend on whether candidates are to be nominated on the basis of accomplishment, or on that of youthful promise. If it is to be a designation for accomplishment the list of nominees to be voted upon should be made up accordingly, with a short statement as to age, past experience, honors, attainments, etc., of each candidate. That only two institutions on the last voting list of chemists should be represented by over 18 per cent. of the nominees indicates a very unsatisfactory distribution. The conditions responsible for this unsatisfactory distribution seem to be (1) a growing tendency on the part of certain strong, influential institutions to exceed their quota of candidates by nominating so-called "young men of promise" and (2) the failure of many directors of research in other institutions to sponsor better known chemists of established scientific attainment.

C. A. BROWNE

SCIENTIFIC BOOKS

X-RAY CRYSTALLOGRAPHY

X-Ray Crystallography. An Introduction to the Investigation of Crystals by their Diffraction of Monochromatic X-Radiation. By M. J. BUERGER, associate professor of mineralogy and crystallography, Massachusetts Institute of Technology. xxii + 531 pp. New York: John Wiley and Sons, 1942. $6.50.

THIS useful book deals with that part of x-ray structural analysis employed to determine for a crystalline substance "the crystal symmetry in the larger sense: the crystal class, the space lattice (its type and dimensions), and the space-group." The material covered is further limited to those techniques which utilize single crystals and monochromatic radiation, thus excluding consideration of the powder and Laue procedures; in point of fact the discussion of the rotating and oscillating crystal techniques, while quite adequate, is incidental to the treatment of the various moving film methods. Although requiring somewhat more complicated equipment, the moving film methods offer the great advantage of registering three film coordinates for each diffraction spot. The author shows how to exploit this and other advantages fully and with great simplicity, particularly for the most important "equi-inclination" Weissenberg method.

Essential theory, design and operation of apparatus, simple indexing procedures, connections with group theory, precision determination of lattice constants—these and related topics are treated in great detail. A discussion of the systematic application of plane-group theory to the interpretation of the observed diffraction symmetries of equi-inclination Weissenberg photographs resulting in a very direct determination of the probable space-group(s) rounds out a definitive treatment of the Weissenberg method. The limitations of any x-ray method for determining the space group of a crystal are properly emphasized, and detailed tables makes clear the specific ambiguities wherever they arise. The inclusion of a brief discussion of auxiliary methods, *e.g.*, observation of face development, tests for piezo and pyro electricity, etc., which frequently aid in the selection of the probable space-group, would have provided additional guidance in this connection.

The book is addressed primarily to those more or less actively engaged in some phase of crystal structure analysis and should be particularly useful to the beginner in the field. Only a quite modest background in physics and mathematics is required, the development is extremely detailed, and the text is replete with excellent diagrams and illustrations. In the opinion of this reviewer and of two of his students who have used the book extensively, the treatment would have gained ultimately in clarity while permitting of some condensation through the more consistent use of elementary vector analysis. A separate section or appendix, giving in one place a complete explanation of the systematic notation now used for space-groups also would have been desirable.

The comprehensive account given of the Weissenberg equi-inclination method should encourage the wider use of this powerful technique. An equally detailed companion volume to continue with the more interesting and more difficult problem of determining atomic positions within the unit of structure would be welcomed, especially by the student beginning the study of structural analysis.

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EXPLOSIVE CHEMISTRY

Laboratory Manual of Explosive Chemistry. By ALLEN L. OLSEN and JOHN W. GREENE. vi + 106 pages. 13.8 × 21.1 cms. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Limited. 1943. Price $1.75.

THE material in this manual has been used by the authors in presenting short courses in explosives under the Engineering Science and Management War Training Program. The book is primarily a compilation of the usual chemical analyses and specifications of the common military explosives. As the authors have stated, the details of testing and the included specifications are those which have been outlined by the War Department in their most recent printing of "Military Explosives, Technical Manual, TM 9–2900." Olsen and Greene have, however, included more detail and have emphasized precautions in manipulations.

The contents have been divided into five chapters: I. Safety. II. Propellants, Raw Materials. III. Propellants, Nitrocellulose and Smokeless Powder. IV. High Explosives. V. Primers, Igniters and Initiators. Following the last chapter is an appendix on "Sampling."

The chapter on "Safety" is valuable but does not place sufficient emphasis on the individual characteristics of explosives and the frequent unpredictability of their behavior. It should be demonstrated to the student that there are three types or classes of explosives and that there is a wide range of behavior in each class. These facts can be made clear by a few simple experiments with such explosives as black powder, smokeless powder, lead azide, nitroglycerin and guncotton.

The text is very limited, for it has nothing to offer the chemist or physicist who is engaged in research on explosives or to any one who is interested in testing the explosive properties of these substances. Although the authors obviously did not have such read-

ers in mind, this expectation would not arise if the title were a less comprehensive one, such as "Chemical Analysis and Specifications of Military Explosives."

The text will be a handy reference for persons engaged in control analysis since the directions are clear and concise. It is, perhaps, a small point, but the reviewer hopes that the phrase "explosive chemistry" occurring in the title of the text does not find common usage. Many students and chemists have had experiences in "explosive chemistry" without having been interested at such times in the "Chemistry of Explosives."

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SPECIAL ARTICLES

GUAYULE PLANTS WITH LOW CHROMOSOME NUMBERS

SUCH Russian workers as Dianova *et al.*[1] and Botschanszeva[2] reported that *Parthenium argentatum* (guayule) usually has 72 chromosomes (diploid number). Recently we learned from G. Ledyard Stebbins, Jr. (personal communication), that he has found among plants from commercial strains from Salinas the following chromosome numbers: $2n = 54$, 58 (± 2), 72, 74 and 108–112.

In the fall of 1942, Dr. LeRoy Powers collected seeds of guayule in Mexico and Powers and Walter T. Federer in the Trans-Pecos region of Texas. Many of the plants grown from seeds collected in Durango, Mexico, have thinner leaves than those of the 72-chromosome types. In general they may be characterized as vigorous growers, early and prolific seed producers. Many are light green in color, probably due to a chlorophyll deficiency. On both light and dark green plants the trichomes are shorter than on plants of higher chromosome number. Eleven of these plants were examined cytologically and were found to have from 36 to 39 chromosomes. They are from four different locations within the mountainous area on the border of which are the towns of Santa Librada, Patinta, Maravillas, Capilla and S. Francisco, southwest of the city of Mapimí.

Chromosome counts were made mostly at the diakinesis and prophase II stages in pollen-mother-cells because chromosomes are better separated then than at metaphase II, although the latter was used whenever possible. Flower heads were prefixed in a mixture of seven parts absolute alcohol and one part glacial acetic acid. Dissected disc florets were stained with synthetic orcein in 45 per cent. acetic acid. Mature pollen grains were stained with aniline blue-lactophenol. Five hundred from each plant were counted to determine the amount of aborted grains. The diameter inside the exine of 100 grains from each plant was measured with an ocular micrometer.

These plants are considered to be diploids because at diakinesis all eleven plants have 18 pairs of chromosomes. A few pollen-mother-cells in one plant seemed to show an association of four chromosomes and in another plant possibly as many as three such associations. Whether these are due to reciprocal translocations or are an indication of polyploidy is not known at present. In addition, most of these plants showed one, two or three very small chromosomes. These very small chromosomes are to be seen also in plants from Texas and in commercial strains. A study of somatic chromosomes seen occasionally in dividing tapetal cell nuclei has led to the supposition that these small chromosomes are the equivalent of the short arm of one of the types of medium-sized chromosomes. Lagging chromosomes were seen in one plant. Chromatid bridges were observed in three other plants.

In addition to these eleven plants, the pollen of another from the same area was studied carefully. Although the amount of aborted pollen varied considerably among the different plants (from 3 per cent. to 60 per cent.) the diameter inside the exine of filled grains was quite uniform. An average of these twelve plants showed that 5 per cent. measured 12.4 μ, 33 per cent. 14 μ, 58 per cent. 15.5 μ and 3 per cent. 17.1 μ. The grains are not absolutely spherical. For comparison, an average of five plants which belong to the 72-chromosome class showed that one per cent. measured 15.5 μ, 9 per cent. 17.1 μ, 57 per cent. 18.6 μ, 27 per cent. 20.2 μ, 5 per cent. 21.7 μ, and one per cent. consisted of giant grains. In addition, a limited examination was made of the pollen of 28 more plants from the same area. Since all showed the same-sized pollen grains as the 12 mentioned above, they also are considered to be diploids having 36 or about 36 chromosomes.

A cytological study also has been made of two dwarf plants from seeds collected in Texas. Both were found recently by Dr. Powers among plants grown from seed collected on the O2 Ranch. They are dwarfed, with thin, crinkled leaves that have a tendency to cup. One had a height of 5 cm and spread of 6 cm compared with nine normal plants in the same collection and culture which averaged 14 cm and 14 cm respectively. The second had a height of 7 cm and spread of 7 cm, while eight normals in the same collection and culture averaged 13 cm and 15 cm, respectively. How-

[1] V. I. Dianova, A. A. Sosnovetz and N. A. Steschina, *Beih. Bot. Centralb.*, 53: 294, 1935.

[2] S. Botschanszeva, *Acta Univ. Asiae Mediae, Tashkent, Ser. VIII b, Botanica:* fasc. 15, 1933.

ever, they have the same coloring as the rest of the plants in the culture which have 72 (±1 or 2) chromosomes. The anthers were shrunken, transparent and practically empty. Among immature anthers a few gigantic, misshapen pollen grains were found, these apparently consisting of the entire pollen-mother-cells which had developed an exine, and a few compound small grains, the results of only partial cytokinesis. A dividing tapetal cell nucleus of one of these plants showed 38 chromosomes, including one very small one. The other plant had 36 to 38 chromosomes, as indicated by an examination of the diakinesis and metaphase I stages in pollen-mother-cells. In both plants only a few bivalents were found at metaphase I. The univalents, of greater length than when associated as bivalents, were scattered somewhat along the axis of the spindle. The walls of the pollen-mother-cells were extremely thin. It was concluded that although these two dwarf plants also belong to the 36-chromosome class, they are to be considered as haploids of the 72-chromosome population in which they occurred.

The contrast in morphological appearance and in chromosome behavior between the 36-chromosome plants from Durango and those from Texas emphasizes the fact that more than mere chromosome number is needed for an understanding of the appearance and breeding behavior of guayule plants. Judging by the plants obtained from seed collected in Mexico and in Texas, the 36-chromosome Durango plants seem to be the only type in certain locations and to comprise an appreciable part of the population in other locations where 54-chromosome plants also occur; whereas the 36-chromosome plants from the O2 Ranch in Texas are among the off-types found in a population that seems to consist almost entirely of 72 (±1 or 2) chromosome plants.

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FATAL ENCEPHALITIS IN MAN DUE TO THE VENEZUELAN VIRUS OF EQUINE ENCEPHALOMYELITIS IN TRINIDAD

BY the early part of October, 1943, approximately seventy cases of fatal encephalitis had occurred among the horses and mules in Trinidad, British West Indies. The epizootic was tentatively diagnosed as equine encephalomyelitis by the local authorities from the clinical symptoms presented. Accordingly, the sector veterinarian of Trinidad, Major R. T. Gilyard, Army of the United States, sent representative portions of brain tissue from two donkeys, two horses and a mule that had died of the disease to the laboratories of the Army Veterinary School, Medical Department Professional Service Schools, Army Medical Center, Washington, D. C., for diagnosis. The first material, that from a donkey, was received on October 11, 1943. Later he submitted brain tissue from a human case of encephalitis that had died on August 22, 1943. Brain tissue was shipped in buffered glycerine by airmail express and arrived within two days after shipment.

A ten per cent. suspension of brain tissue was prepared from each of the six cases and injected intracerebrally in 0.1 cc amounts into two guinea pigs, and in 0.03 cc amounts into three Swiss mice. The inoculated animals presented typical symptoms of equine encephalomyelitis in periods varying from three to eight days. They were sacrificed while in a moribund condition and their brains removed for further study.

The laboratory animals inoculated with brain suspensions from the donkeys, horses and mule became prostrate within 96 hours. Those inoculated with the human brain tissue became prostrate by the eighth day. This may be explained by the fact that brain tissue from the animals was received within two to three days after autopsy, whereas the human brain tissue had been held in Trinidad for six weeks in buffered glycerine solution under refrigeration before it was shipped to this laboratory.

Laboratory animals infected with virus from each of the six cases were sacrificed when prostrate, their brains removed, and when found to be bacteriologically sterile were prepared for typing of the viruses.

These six strains of virus when isolated were injected intracerebrally into each of three groups of guinea pigs; one group immunized against Western type virus, the second group against the Eastern type and a third group of normal animals. The groups of Western immune and normal guinea pigs died within 96 hours and in the Eastern immune group the death period extended to the fifth or sixth day, a condition that has previously been noted in Eastern type immune animals injected with the Venezuelan equine encephalomyelitis virus.[1] The results on the animal brains were reported to Major Gilyard on October 21, 1943.

By this time we had obtained Venezuelan equine encephalomyelitis vaccine and immunized a group of guinea pigs. Two weeks after completion of vaccination this group exhibited no illness following intracerebral injections of the six isolated viruses, indicating that the virus was the Venezuelan type in all six instances. Guinea pigs immunized against the Eastern and Western viruses and normal animals served as controls.

[1] C. E. Beck and R. W. G. Wyckoff, SCIENCE, 88, 530, 1938.

Of the three immunologically different strains of equine encephalomyelitis viruses known to be present in the Western Hemisphere, fatal human cases due to the Eastern type virus were established by Fothergill, Dingle, Faber and Connerly[2] in 1938, and somewhat later in the same year Howitt[3] reported the isolation of the Western type virus from a fatal human case.

Although Venezuelan type equine encephalomyelitis in man may have been suspected,[4] there is record of only two cases having been reported. These were of a very mild type and occurred in the United States in laboratory personnel working with the virus.[5]

The present report records the first instance in which the Venezuelan strain of equine encephalomyelitis virus has been proven to occur naturally in man, producing a fatal infection. Further, it establishes the fact that all three strains of equine encephalomyelitis viruses known to be present in the Western Hemisphere are capable of producing a fatal encephalitis in man.

From available information, this is the first outbreak of equine encephalomyelitis in Trinidad, B. W. I., and immunity tests have proven it to have been caused by the Venezuelan strain of virus.[6]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

MULTIPLE ELECTRODE HOLDER FOR THE HORSLEY-CLARKE INSTRUMENT

FOR electroencephalographic study of the interior of the animal brain an apparatus to hold several electrodes in place simultaneously is essential. Specifications were submitted to Mr. R. Kittel, Chicago, the maker of the Horsley-Clarke instrument, who designed and constructed a satisfactory attachment. Three bakelite rectangles, each 46 × 57 mm and about 1 mm thick, were drilled with holes to fit No. 11 bead needles coated with insulating varnish. The holes are in 41 rows 1 mm apart, and each row has 31 holes 1 mm apart. The three plates were then fastened together with screws at the corners, using metal sleeves on the screws to hold the plates 5 mm apart. The complete assembly is equivalent to a block 13.5 mm thick. It is mounted on a brass frame attached by screws at four points to the upper lateral bars of the Horsley-Clarke instrument. When in place, needles in the holes are vertical with respect to the brain. An adjustment on the frame allows the multiple holder to be moved laterally, so that the center row of holes can be placed exactly over the midline.

Insulated bead needles inserted through the holes in the holder into the brain keep their positions without fastening. The depth of a needle point in the brain is controlled by measuring the length of needle exposed above the upper surface of the multiple holder. Since this upper surface is 46 mm above the interaural plane, and a needle is 53 mm in length, the needle point is at the interaural plane if 7 mm of needle remains exposed. Connections to the amplifier and stimulating device are made by inserting fine copper wires through the eyes of the needles. As many needles can be used at one time as there are points on the selector switches.

The holes in the multiple carrier now in use will do for 26-gauge hypodermic needle tubing if it is desired to use shielded electrodes. It was not necessary to order the drilling of so many holes. The attachment would be just as useful, and less expensive, if it had about 800 holes, properly placed, instead of 1,271.

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[2] L. D. Fothergill, J. H. Dingle, S. Faber and M. L. Connerly, *New England Jour. Med.*, September 22, 1938.
[3] B. Howitt, SCIENCE, 88, 455, 1938.
[4] Mentioned in: A. S. Lleras and L. Figueroa, Biol. Inst. Nac. Hig. Semper Martinez, 1942, 8, 3.
[5] J. Casals, E. C. Curren and L. Thomas, *Jour. Exp. Med.*, 77, 521, 1943.
[6] Since this manuscript was submitted an additional eight non-fatal cases of infection acquired in laboratory workers were reported by E. H. Lennette and H. Koprowski, *Jour. Am. Med. Asn.*, 123: 1088, 1943.

BOOKS RECEIVED

GLASSER, OTTO and OTHERS. *Medical Physics.* Illustrated. Pp. xlvi + 1744. The Year Book Publishers, Inc. $18.00.

JOHNSON, WILLIAM H. and LOUIS V. NEWKIRK. *Modern Drafting.* Illustrated. Pp. vii + 197. Macmillan Company. $2.50.

NEWMARK, MAXIM. *Illustrated Technical Dictionary.* Pp. 352. The Philosophical Library. $5.00.

POPE, FRANCIS and ARTHUR S. OTIS. *The Airplane Power Plant.* Illustrated. Pp. iii + 188. World Book Company.

REEVE, WILLIAM DAVID. *Essential Mathematics.* Illustrated. Pp. iv + 282. The Odyssey Press.

Rose's Foundations of Nutrition. Fourth edition. Revised by GRACE MACLEOD and CLARA MAE TAYLOR. Illustrated. Pp. xi + 594. Macmillan Company. $3.75.

SHUTE, WILLIAM GEORGE, WILLIAM WRIGHT SHIRK, GEORGE FORBES PORTER and COURTENAY HEMENWAY. *An Introduction to Navigation and Nautical Astronomy.* Illustrated. Pp. xiv + 457. Macmillan Company. $4.50.